

bars and isotherms for the West Indies, the Caribbean Sea, and the Gulf of Mexico. Probably the most interesting station on this chart is that of Colon, at which point the observations give us clear evidence that the equatorial belt of low pressure on the Pacific Ocean here crosses over into the Caribbean Sea. There can be no doubt but that the flow of northerly winds over the United States is often due as much to a deficiency of pressure in the Caribbean Sea or in Brazil as to an excess of pressure in North America. The study of the equatorial regions is certainly quite as important to the meteorologist as the study of the polar regions, a phase of the question that was especially dwelt upon in 1881 when discussing the necessity of the great international polar work. It is to be hoped that the publication of these charts, which have been kindly prepared by Mr. A. J. Henry, will prove of great service in attracting attention to the meteorology of this portion of the globe. We have on many occasions explained in the MONTHLY WEATHER REVIEW how this eastern end of the Pacific trough of low pressure turns northward in the summer season and reaches into Arizona. In that Territory, as at Colon, the low pressure is not a direct result of local temperature, but is a feature that belongs to the general circulation of the atmosphere.

Beginning with the month of March we hope to be able to complete the western portion of this map by making use of the data published on the daily and monthly maps of the Mexican service.

THE AMERICAN METEOROLOGICAL JOURNAL.

The Editor has received from one of our voluntary observers, a request for Vol. I, No. 1 of the American Meteorological Journal, and not being able to supply this number, takes the liberty of making this request known, in hope that some one may have a copy to spare.

The librarian of the Weather Bureau would like to obtain Nos. 1, 2, and 3 of Vol. II.

Prof. H. A. Hazen would like to obtain a personal copy of Vol. II, No. 2.

In general, copies of Volumes IX-XII may be purchased of the publisher by those who wish to complete their sets.

VERTICAL TEMPERATURE GRADIENTS.

Mr. J. S. Hazen, voluntary observer at Springfield, Mo., notes a remarkable difference of temperature within 90 feet of the ground at that place on March 26. He says:

The station thermometer is located in its shelter, 90 feet above an extra thermometer, which latter was 3 feet above a level lawn. The following comparative readings were taken:

Time.	Thermometer.		
	In shelter, 93 feet above lawn.	3 feet above lawn.	Difference.
9 a. m.	32.2	36.5	4.3
10 a. m.	33.0	37.4	4.4
11 a. m.	33.0	37.7	4.7
12 a. m.	33.3	38.5	5.2
1 p. m.	33.5	38.9	5.4
3 p. m.	35.0	40.6	5.6
4 p. m.	34.2	39.0	4.8
5 p. m.	34.0	35.1	1.1

The observer's attention was first called to the peculiar condition by noticing that the trees and various other objects were covered with a heavy coating of ice down to about twenty feet from the ground, while the lower branches of the trees and the surface of the ground was entirely free from any evidence of ice.

The night of the 25-26th was cloudy, with light fog early in the morning and the day following. The humidity was high, and the air impressed one as being damp, heavy, and penetrating.

Two thunderstorms of slight intensity occurred during the 26th, one shortly before 11 a. m., and the other about 2 p. m., and both were accompanied by hail. The hailstones were about the size of peas.

The line of demarcation between the warmer surface air and colder air above was sharply and distinctly drawn, but the colder air gradually encroached upon the warmer body of air. It was noted that during the first hailstorm the ice remained in the sloping gutter of a shed roof down to about twenty feet above the ground, but after the second storm the ice was extended down to within less than ten feet from the surface of the ground, while lower than that no ice remained.

It is believed from the amount of ice on the trees that the temperature was probably lower at a height of about fifty feet from the ground than it was in the instrument shelter, but there was no way of taking the temperature at that elevation. Ice began to form on the ground shortly after 8 p. m.

It has been suggested that—

If the air at the surface of the ground was unusually dense, by reason of pressure and humidity, still the cold brisk breeze a hundred feet above the ground would force a mixture between the cold air above and the warm air below in a very short time. It is, therefore, considered by some as remarkable that the colder air above should have encroached so gradually upon the warm air below.

The Editor would remark that the question is not one of pressure or humidity but of temperature, and that our first consideration must be to ascertain the relative reliability of the observed temperatures at 3 and 93 feet, respectively, above the lawn. On this point a letter of inquiry was immediately addressed to the observer who replied:

The temperature was obtained from a standard Weather Bureau thermometer, which was attached to a small stake, driven into the ground. There was no covering or obstructions around the thermometer, but as the weather was densely cloudy, the exposure was deemed good. There was a clear lawn space around the instrument of at least 50 feet.

As this exposure of a thermometer is wholly unsatisfactory, it would be improper to attempt to draw any refined conclusions from the comparison of the upper and lower temperatures.

When questions of a few degrees Fahrenheit are propounded in meteorology, the method of determining the temperature of the air is of paramount importance. Every one who has examined the subject now recognizes the fact that a thermometer does not show the temperature of the air unless all injurious radiation has been annulled either by protecting screens or by a rapid flow of air, or by the rapid whirling of a thermometer. In the present case, it is quite plausible that the temperature at the level of the lawn between 9 a. m. and 5 p. m. was higher than at the level of the instrument shelter 93 feet above the lawn, but the amount of this difference in degrees can not be satisfactorily deduced from these observations. It is not likely that the true difference was very large because, as the observer states, the weather was densely cloudy. The only way in which this difference could be determined with an accuracy of one-half a degree Fahrenheit, would be by using standard thermometers at the upper and lower station, well screened against all radiations, and well ventilated either by the natural wind or by whirling them, as with a sling psychrometer, or by causing a rapid draught as in the Assman psychrometer. A full description of the various methods of determining the temperature of the air is given in the Editor's Treatise on Meteorological Apparatus and Methods, published as Part 2 of the Annual Report of the Chief Signal Officer for 1887. Recent special investigations have been published by the Seewarte at Hamburg and the Meteorological Office at Berlin.

Errors of several degrees Fahrenheit are liable to be incurred when a thermometer is simply hung in the open air without protection from radiation and without special ventilating currents. In the present case if the trees and other objects twenty feet above the ground were covered with ice and the sun's rays did not penetrate through the thick clouds, we should naturally expect that streams of cold air from the ice would settle down to the ground, and that the temperature at 3 feet above the lawn would be as cold, if not colder, than